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Computer Security Controls & Financial Statement Audits

Presented at the Federal Financial Statements Update Conference (PCIE / FAEC)

July 20, 1999

GAO Agenda

- Computer Control Assessments
  - Why needed and results of
  - Penetration testing
- Federal Information System Controls Audit Manual (FISCAM)
- Questions and Answers

GAO Significance of Information Security Audits

- Increasingly important aspect of control over critical operations, assets, and data
- Legislation calls for improvements in systems and internal controls
- GAO High-Risk Area - Problems identified in all 24 CFO agencies
- Increased Congressional interest

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Increased Inherent Risks

- Speed and accessibility
- Increased computer skills
- Availability of hacking tools
- Little paper backup
- More reliance on computer controls
- Trend toward providing broad access

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Information System Risks

- Modification or destruction of data
- Loss of Assets
- Release of sensitive information (taxes, social security, medical records, other)
- Disruption of critical operations

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Impact on Financial Audits

- Generally, computer control weaknesses result in:
  - ineffective overall controls and
  - inability to lower assessment of control risk to reduce testing

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Audit Requirement Concerning Information System Controls

- "A sufficient understanding of internal control is to be obtained to plan the audit and to determine the nature, timing, and extent of tests to be performed."

  AICPA's second standard of fieldwork

- "..the auditor shall obtain an understanding of the components of internal control … Such controls include the relevant EDP general and application controls."

  OMB Bulletin No. 98-08

General Control Assessment

Material weaknesses

- Entitywide Security Program
- Access Controls
- Application Software
- System Software
- Segregation of Duties
- Service Continuity

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Entitywide Security Program

- Weaknesses at all agencies reviewed
  - No risk-based security plans
  - Undocumented policies
  - Inadequate monitoring program
  - Lack of coordinated security function

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Entitywide Security Program - Risks

- Entity is unaware of its vulnerabilities
- Employees are unaware of their security related responsibilities
- Control consciousness of entity is ineffective or non-existent
- Non-compliance with Computer Security Act
- Fraud not detected

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Access Controls

- Most widely reported problem area
  - Overly broad access, not periodically reviewed
  - Undocumented access granted
  - Poor id and password management
  - Improper implementation of software controls
  - Inadequate monitoring of user activity

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Access Controls - Risks

- Unauthorized changes to data or programs could be used to hide misappropriation of assets
- Unauthorized transactions
- Unauthorized access to confidential data
- Other malicious activity

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Application Development and Change Control

- Undisciplined testing procedures
- Unauthorized software and software changes
- Inappropriate access to software

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Application Software Development and Change Control - Risks

- Programming errors may cause inaccurate information
- Unauthorized program changes may allow controls to be bypassed or omitted
- Introduction of unauthorized transactions
- Introduction of malicious software (e.g., viruses)

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System Software

- Inadequately controlled access to powerful system software
- Inadequate monitoring of authorized users

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System Software - Risks

- Security features may be compromised
- Unauthorized changes to data or programs used to cover fraud
- Data may be processed in error
- Service interruptions through system failures

Segregation of Duties

- Excessive responsibilities
  - Develop, test, review, and approve software changes
  - Perform all steps needed to initiate and complete a payment

GAO Segregation of Duties - Risks

- Errors or fraud may occur and not be detected
- Theft of assets concealed by changes to records

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Service Continuity

- Incomplete plans
- Incomplete testing

GAO Service Continuity - Risks

- Loss of critical or sensitive data
- Operations may not be restored in a timely manner
- Expensive recovery procedures
- Control procedures that exist in normal operation may be short cut during recovery process

GAO Agency Computer Control Evaluations

- Coverage of all FISCAM areas
- Reporting findings
- Multi-year strategies

Penetration Testing

Using automated tools and techniques to identify security exposures from internal and external threats

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Applying Penetration Tools and Techniques to an IS Audit

Introduction and Background
Common Vulnerabilities
Targets
Test Scenarios
Planning
Terms of Engagement
Tools and Techniques

GAO Position

- Use penetration as part of all general control reviews
- Use penetration testing in selected sensitive areas
- Encourage Inspectors General to use

GAO Common Vulnerabilities

- Weak Passwords
- Default Accounts and Passwords Not Changed
- Repeated Bad Logon Attempts Allowed
- No Real-Time Intrusion Detection Capability
- Unpatched, Outdated Vulnerable Services
- Running Unnecessary Services
- Misconfigured File Sharing Services
- Inappropriate File Permissions
- Excessive Admin & User Rights

GAO Common Vulnerabilities (cont.)

- Clear Text transmissions of Sensitive Information
- Unsecured Dial-In Modems
- Inadequate Filtering
- Inadequate Logging, Monitoring & Detection
- Excessive Trust Relationships
- Information Leakage
- Inadequate Segregation of Duties
- Inadequate Warning Banners

Tools and Techniques

Internet Available Tools and Information

- Freeware
- Shareware
- Commercial Software

Targets

Sensitive Applications and Data

Tier I Systems	Mainframe
Tier II Systems	Minicomputer
Tier III Systems	Network Systems

GAO Targets (cont.)

Platforms	Examples
Mainframe	MVS, VM, Unisys ...
Minicomputer	Unix, VMS, AS/400 ...
Network	Windows NT, NetWare, Firewalls, Web, Proxy & Mail Servers, Routers, Hubs, Dial-in Modems ...

GAO Test Scenarios

Scenario	Facility Info	Physical Access	Logical Access	Test Paths	Test Type
Outsider	Little or None	No	No	-Dial-In -Internet	Hacker or Cyber-Terrorist
Outsider	Medium to High	No	No	-Dial-In -Internet	Former employee, contractor or temp
Insider	Medium	Yes	No	-Unused connections -Unattended workstations	Disgruntled or dishonest employee, contractor or temp
Insider	High	Yes	Yes	-Work-stations -WAN	Disgruntled or dishonest employee, contractor or temp

Planning

Terms of Engagement

- Define Scope
- Address Risks
- Identify Roles and Responsibilities
- Determine Logistical Requirements

Terms of Engagement
Define Scope

Test Parameters

- What — What is to be tested?
- When — Timeframe
  Stopping Points
- Where — From what locations?
- Who — Who will perform testing?
- How — What tools & techniques?

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Terms of Engagement Address Risks

- Risks cannot be eliminated but must be minimized to an acceptable level
- Acceptance of risks by System Owners

Terms of Engagement
Address Risks (cont.)

Steps to Minimize Risks

- No Denial of Service
- Coordinate Testing
- Have Knowledgeable Site Personnel Monitor All Testing
- Log Test Settings
- Maintain Detailed Log of All Tests & Results
- Use Network Analyzers
- Test During Non-Peak Hours (if necessary)

Terms of Engagement
Define Roles & Responsibilities

Participants

- Contractors
- Test Team
- EDP Auditors
- System Owners (CIO & Functional Area Mgr.)
- Security Officer
- System Administrators

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Terms of Engagement
Identify Logistical Requirements

- IP Addresses
- Telephone Ranges (exclude sensitive no.'s)
- Control of Sensitive Information
- Secure Workspace
- Analog Telephone Lines
- Internet Access
- User Accounts and Passwords
- Levels of Access
- Network Connections
- IP Assignment
- Workstations

GAO Tools and Techniques

- Data Gathering
  whois, finger, ping, traceroute, Web pages, phone book, …
- Scanning
  Port Scanners - ISS, CyberCop Scanner, …
  Modem Dialers - ToneLoc, Phonetag, ...
- Data Extraction, Analysis & Testing
  Standard OS commands and utilities
  Automated Tools - DumpACL, CA-Examine, NetXRay, Keycopy ...
- Password Cracking
  L0phtCrack (NT), John the Ripper (Unix), Pandora (Novell), ...
- Social Engineering
  Help desk, employees, contractors, temps ...

GAO New Guides and Tools

- Federal Information System Controls Audit Manual (FISCAM)
- Executive Guide - Information Security Management: Learning From Leading Organizations (GAO/AIMD-98-68)
- Information Security Risk Assessment: Practices of Leading Organizations (Draft)

GAO FISCAM - Purpose

- At first, developed to support our financial statement audits
- Now, is also used during non-financial audits
- Describes elements of a full-scope information security audit from which auditor can select elements that support job objectives

FISCAM and Financial Audit Manual

Four Phases

- Planning
- Internal Control
- Testing
- Reporting

GAO FISCAM - Organization of Manual

- Chapter 1 - Introduction and General Methodology
- Chapter 2 - Planning the Audit
- Chapter 3 - Evaluating and Testing General Controls
- Chapter 4 - Evaluating and Testing Application Controls
- Appendixes

GAO FISCAM - Chapters 3 and 4

- Describe broad control areas; provide criteria
- Identify critical elements of each control area
- List common types of control techniques
- List suggested audit procedures

Chapter 3 - Evaluating and Testing General Controls

Six general control areas covered

- Entitywide Security Program Planning and Management (SP)
- Access Control (AC)
- Application Software Development and Change Control (CC)
- System Software (SS)
- Segregation of Duties (SD)
- Service Continuity (SC)

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Critical Elements - Entitywide Security Program

- Assess risks
- Document plan
- Establish management structure; assign responsibilities
- Implement personnel policies
- Monitor program’s effectiveness

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Critical Elements - Access Controls

- Classify resources by criticality and sensitivity
- Identify authorized users and access authorized
- Establish physical and logical controls
- Monitor access, investigate violations, and take action

GAO Critical Elements - Application Software Development and Change Control

- Programs and modifications are authorized
- Test and approve all new and revised software
- Control software libraries

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Critical Elements - System Software

- Limit access to system software
- Monitor access to and use of system software
- Control system software changes

Critical Elements - Segregation of Duties

- Segregate incompatible duties and establish related policies
- Establish access controls to enforce segregation of duties
- Control activities through operating procedures and supervision and review

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Critical Elements - Service Continuity

- Assess criticality of operations and identify supporting resources
- Take steps to prevent and minimize potential damage and interruption
- Develop and document a comprehensive contingency plan
- Periodically test plan and adjust as appropriate

Chapter 4 - Application Controls

- Apply to the processing of individual applications

- Designed to ensure that transactions are
  - valid
  - properly authorized
  - completely and accurately processed

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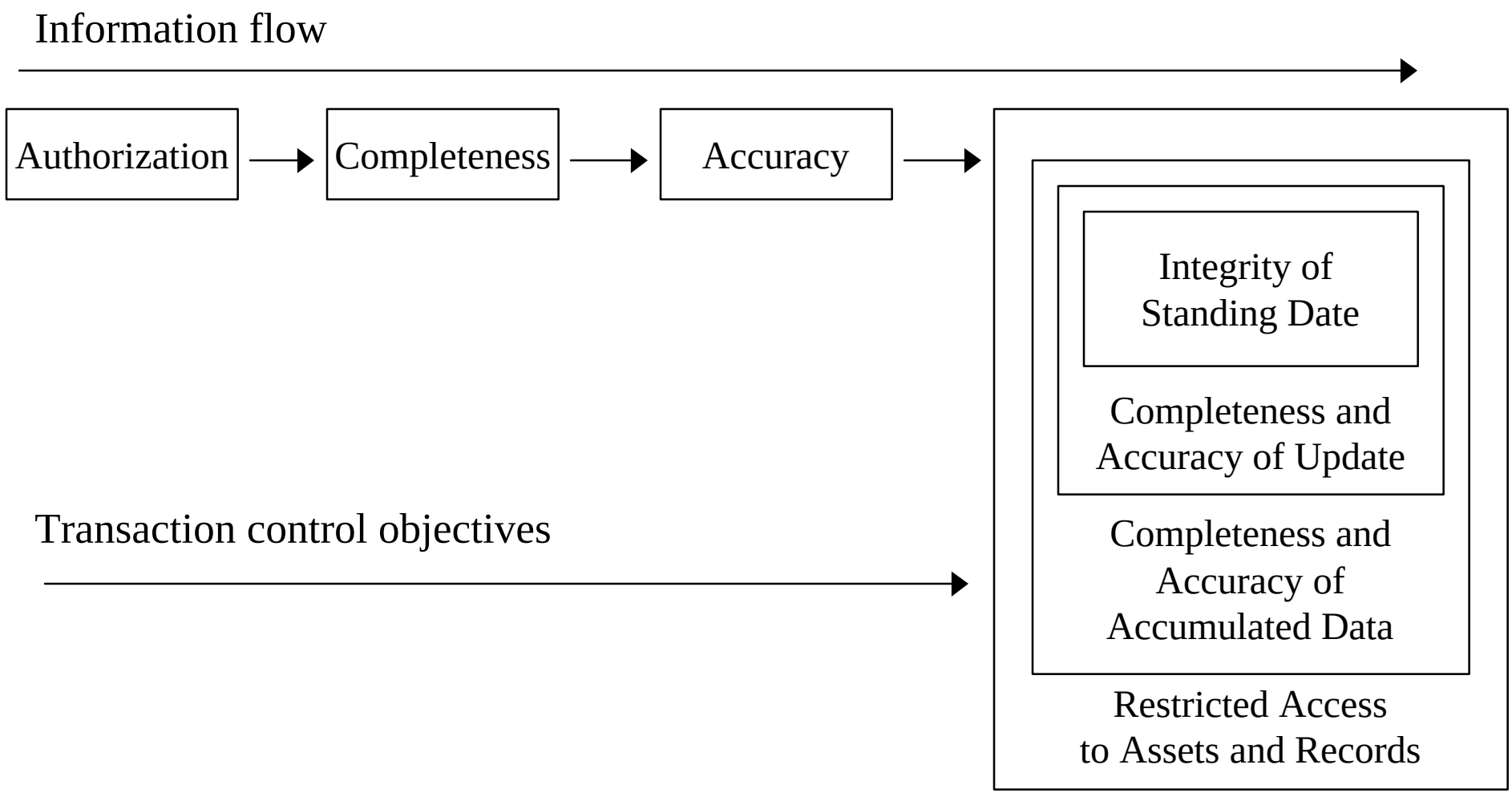
CONTROLS OVER APPLICATIONS
Overview of Objectives to Consider



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Application controls consist of:

- Initial controls related to the control of information prior to system input
- Programmed controls, such as edits, and
- Manual follow-up of EDP produced reports, such as exception reports or reconciliations

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Critical Elements - Authorization Controls

- All data are authorized before entering the application system
- Restrict data entry terminals to authorized users for authorized purposes
- Master files and exception reporting help ensure all data processed are authorized

GAO Authorization Controls - Risks

- Unauthorized transactions may
  - generate fraudulent payments
  - cover up fraudulent activity
  - cause malicious data manipulation

- Transactions exceeding given parameters may not receive the higher management review required

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Critical Elements - Completeness Controls

- All authorized transactions are entered into and processed by the computer
- Reconciliations are performed to verify data completeness

GAO Completeness Controls - Risks

- All Transactions are not received, entered, or processed by the computer
- Missing transactions are not detected
- Rejected transactions are not re-entered
- Duplicate transactions are not prevented

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Critical Elements - Accuracy Controls

- Data entry design features contribute to data accuracy
- Data validation and editing are performed to identify erroneous data
- Erroneous data are captured, reported, investigated, and corrected
- Review of output helps to maintain data accuracy and validity

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Accuracy Controls - Risks

- Data are initially recorded or entered incorrectly
- Inaccurate data may not be identified and corrected

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Application Controls - Common Control Techniques

- Authorization routines
- Segregation of duties
- Computer matching
- Computer sequence check
- Agreement of batch totals
- One for One checking
- Edit checks
- Reconciliations of file totals
- Exception reporting
- Detailed file data checks
- Data access security controls
- Physical access controls

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Example of Control Activities/Techniques and Audit Procedures

Control Activities	Control Techniques	Audit Procedures
SP-3.3 Owners and users are aware of security policies	An ongoing security awareness program has been implemented. It includes first-time training for all new employees, contractors, and users, and periodic refresher training thereafter. Security policies are distributed to all affected personnel, including system/application rules and expected behaviors.	Review documentation supporting or evaluating the awareness program. Observe a security briefing. Interview data owners and system users. Determine what training they have received and if they are aware of their security-related responsibilities. Review memos, electronic mail files, or other policy distribution mechanisms. Review personnel files to test whether security awareness statements are current.

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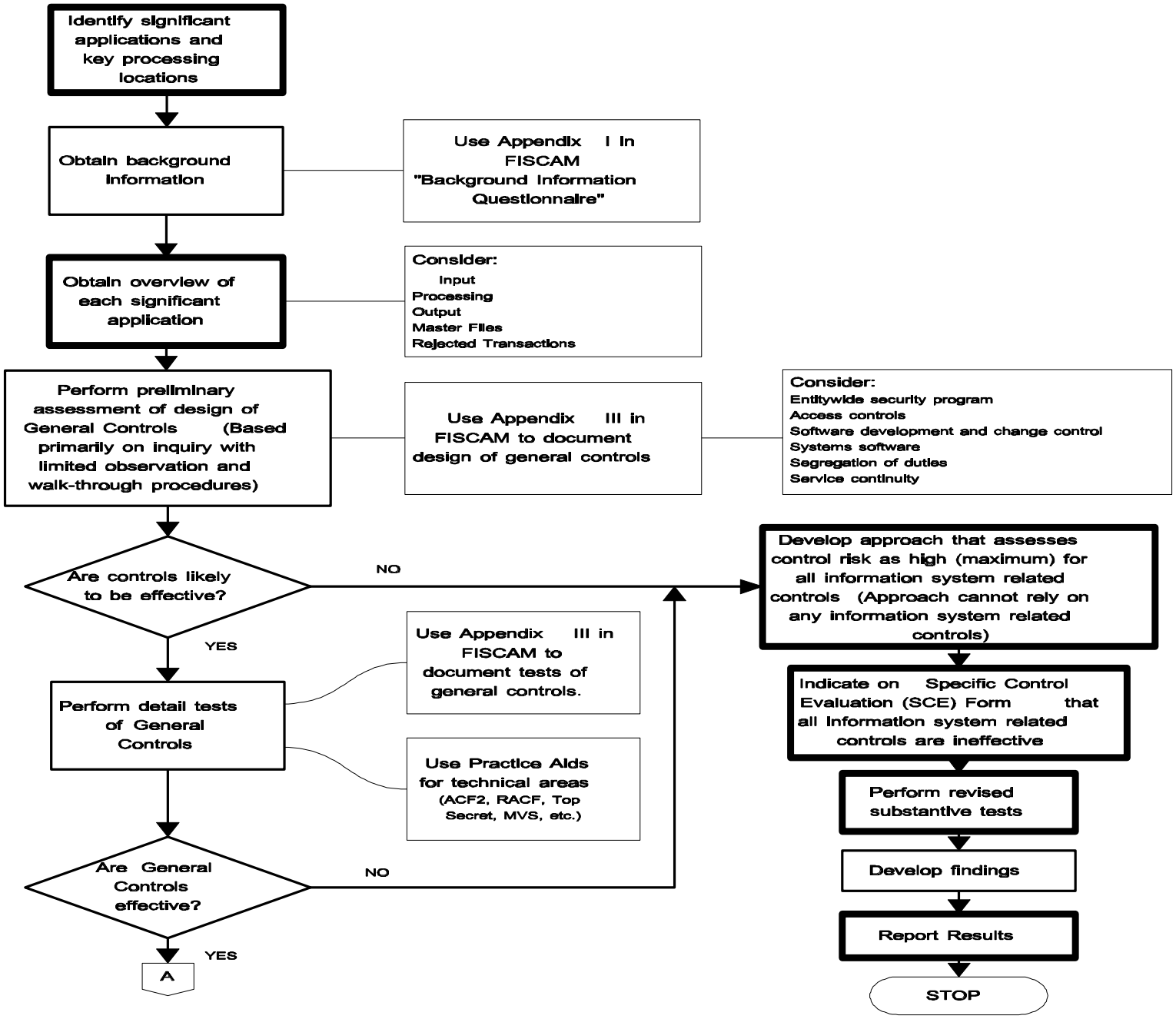
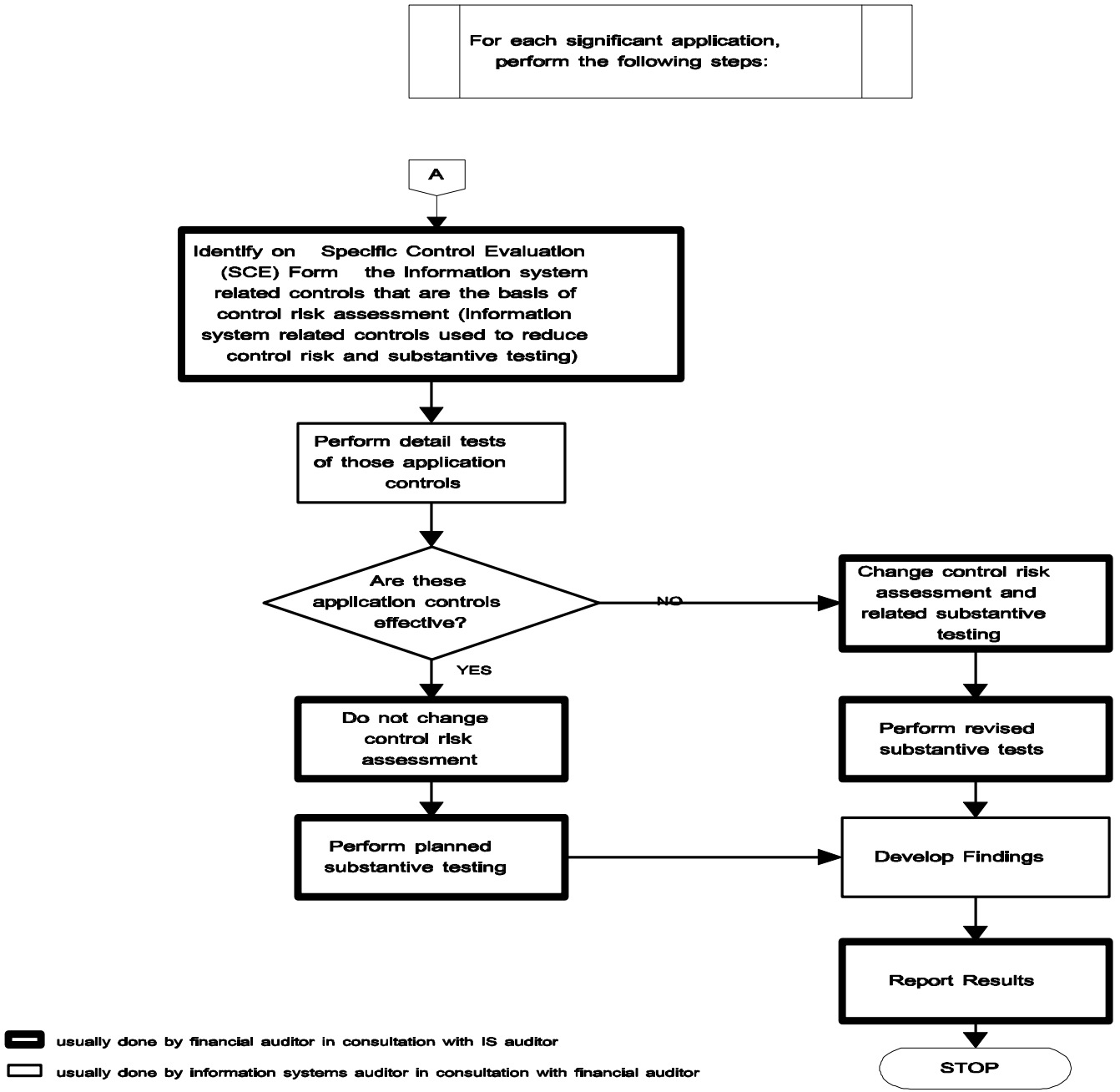
FISCAM Appendices

- Questionnaires on background information and user satisfaction
- Tables for summarizing work performed and assessment of control effectiveness
- Knowledge, skills and abilities
- Audit planning strategy
- Glossary
- Principles for managing an information security program

Steps in Assessing Information System Controls In a Financial Statement Audit



Steps in Assessing Information System Controls In a Financial Statement Audit -- (continued)



Best Practices

Information Security Management: Learning from Leading Organizations (GAO/AIMD-98-68)

- Addresses an underlying cause of ineffective security controls
- Supplements FISCAM information on security program planning and management
- Final guide issued in May 1998

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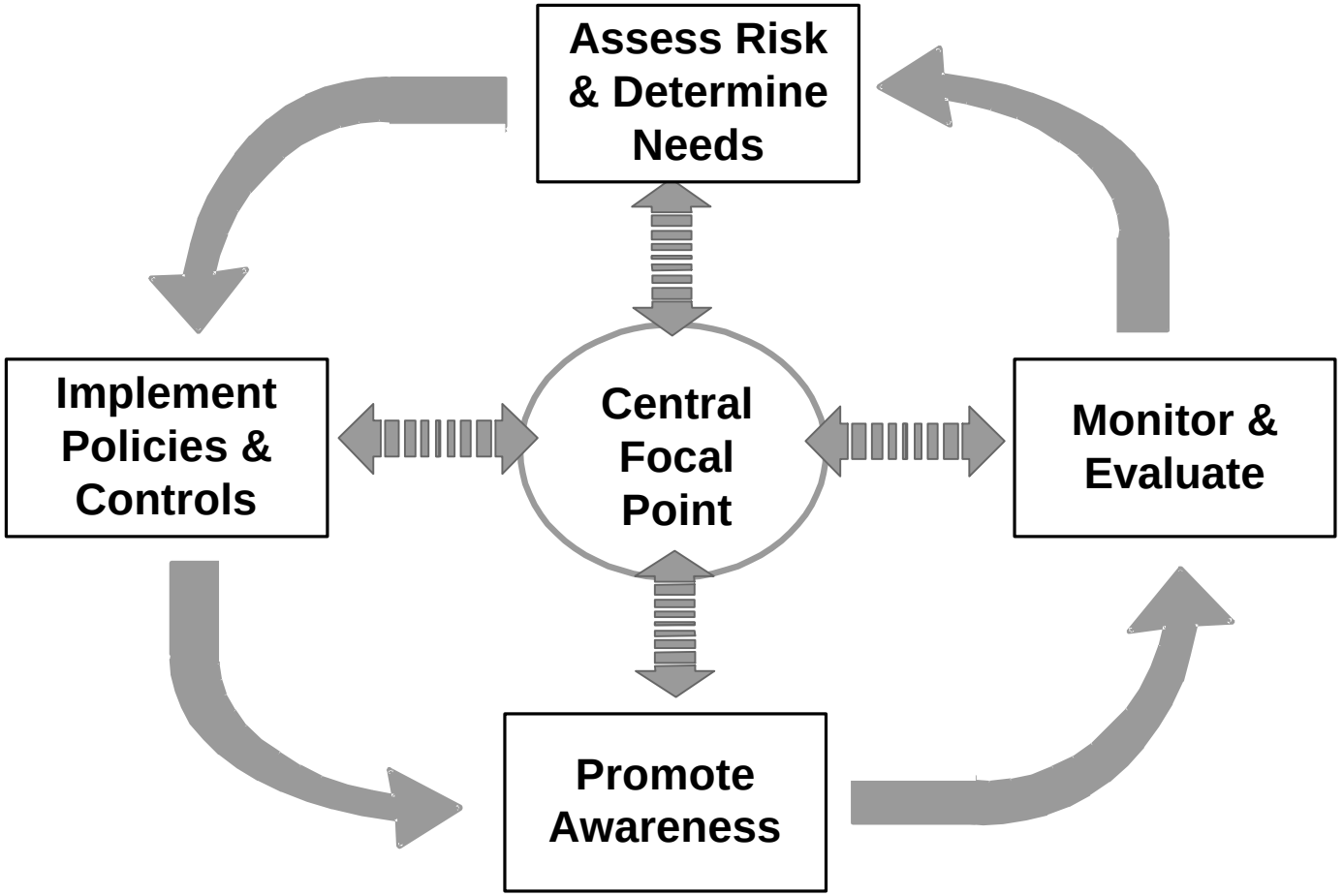
Risk Management Cycle



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Available on GAO's Internet Web Site **<http://www.gao.gov>**

- FISCAM (GAO/AIMD-12.19.6, January 1999)
- Information Security: Serious Weakness Place Critical Federal Operations and Assets at Risk (GAO/AIMD-98-92, September 1998)
- (GAO/AIMD-98-175, September 1998)
- (GAO/AIMD-99-10, October 1998)

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Questions and Answers